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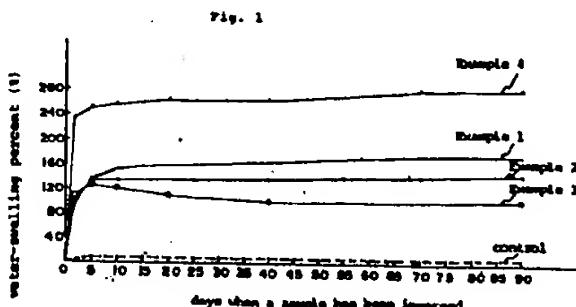
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### 54 WATER-SWELLABLE SEALANT.

57 A water-swellable, humidity-curing type of one-pack polyurethane sealant containing as necessary ingredients (1) a water-swellable urethane prepolymer having 1.5 to 10% terminal NCO groups and being prepared by reacting a polyoxyalkylene ether polyol in which oxyethylene group accounts for 50 to 90% of the total oxyalkylene chain molecular weight with a polyisocyanate, (2) a water-nonswellable urethane prepolymer containing terminal NCO groups and being obtained by reacting a polyoxyalkylene ether polyol having C<sub>3</sub> to C<sub>4</sub> alkylene groups with a polyisocyanate, and (3) a filler, has an improved storage stability.



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## WATER SWELLABLE SEALANT

## [Field of the Invention]

The present invention relates to water-swellable moisture-curing one-package polyurethane sealant of which storage stability is improved.

More particularly, the present invention relates to water-swellable moisture-curing one-package polyurethane sealant which has rapid curing rate, short time to tack free, excellent mechanical strength of cured material, and excellent water-stopping effect.

## [Description of the Prior Art]

One package type polyurethane sealant was conventionally in wide use for sealing material, binder, and caulking material in the field of public and construction works. Recently, water-swellable material is gradually being popularized in order to improve water-stopping effect on the joint sealing or hume pipes. Water-swellable one-package sealant is extremely required in the public and construction works for easy workability and excellent water-stopping effect.

Japanese patent (examined) 49-30209 discloses a fairly good polyurethane sealant. It has, however, insufficient storage stability in the case of adding filler in order to adjust to the practical use. This is caused by the viscosity increasing or partial curing induced by the reaction of the water in the filler and urethan prepolymer.

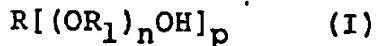
## [Summary of the invention]

We studied the storage stability of the sealant and discovered that the mixture of specific water-swellable

polyurethane prepolymer and non water-swellable polyurethane prepolymer gives water-swellable moisture-curing one-package polyurethane prepolymer which possesses remarkably improved storage stability.

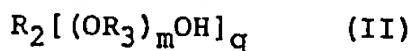
The water-swellable moisture-curing one-package polyurethane sealant of the present invention essentially comprises,

(1) water-swellable polyurethane prepolymer having 1.5-10 % of terminal NCO group content obtained by reacting polyisocyanate with one or more polyetherpolyol having the following general formula,



(where R is polyhydric alcohol radical;  $(OR_1)_n$  is polyoxyalkylene chain comprising 50-90 weight % of oxyethylene unit and 50-10 weight % of oxyalkylene unit having 3-4 carbon atoms; n is the number which represents the polymerization degree of said polyoxyalkylene chain, such n restricts the hydroxy group equivalent of the said polyetherpolyol (1) 500 - 4000; p is the number of 2-8)

(2) non water-swellable polyurethane prepolymer having terminal NCO groups obtained by reacting polyisocyanate with one or more polyetherpolyol having the following general formula,



(where  $R_2$  is polyhydric alcohol radical;  $(OR_3)_m$  is polyoxyalkylene chain comprising oxyalkylene unit having 3-4 carbon atoms; m is the number which represents the polymerization degree of said polyoxyalkylene chain, such m restricts the hydroxy group equivalent of said polyetherpolyol (2) 500 - 4000;

q is the number of 2-8)

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and (3) filler.

[Detailed Description of the Invention]

The preferred examples of the polyhydric alcohols which corresponds R in the above general formula (I) are aliphatic dihydric alcohols (ethylene glycol, propylene glycol, 1,4-butylene glycol, neopentyl glycol etc.), aliphatic trihydric alcohols (glycerol, trioxyisobutane, 1,2,3-butanetriol, 2-methyl-1,2,3-propanetriol, 2-ethyl-1,2,3-butanetriol, 2,3,4-pantanetriol, 2,3,4-hexanetriol, 4-propyl-3,4,5-heptanetriol, 2,4-dimethyl-2,3,4-pantanetriol, pentamethylglycerol, pentaglycerol, 1,2,4-butanetriol, 1,2,4-pantanetriol, trimethylolpropane etc.), aliphatic tetrahydric alcohols (erythrone, pentaerythrone, 1,2,3,4-pantanetetrol, 2,3,4,5-hexanetetrol, 1,2,3,5-pantanetetrol, 1,3,4,5-hexanetetrol etc.), aliphatic pentahydric alcohols (adonite, arabit, xylit etc.), aliphatic hexahydric alcohols (sorbit, mannit, idite etc.). The preferred polyhydric alcohols are di, tri, or tetrahydric alcohols, particularly propylene glycol and glycerol.

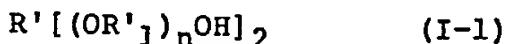
Polyetherpolyols represented by the above general formula (I) can be obtained by adducting ethylene oxide and alkylene oxide having 3-4 carbon atoms to the said polyhydric alcohols with conventional method, so as to get proper molecular weight and ethylene oxide unit content. While ethylene oxide and alkylene oxide having 3-4 carbon atoms can be adducted in the random or block to form polyetherpolyols, the former is preferred in the present invention. The preferred examples of the alkylene oxide having 3-4 carbon atoms are propylene oxide and butylene

oxide, particularly propylene oxide.

The content of the oxyethylene unit in the polyetherpolyol is 50-90 weight %. If the content is over 90 weight %, polyurethane prepolymer having NCO group may crystallize at the room temeprature to lose good workability. If the content is below 50 weight %. the effect of the present invention is not found. The 50-90 weight % of the ethylene oxide unit is particularly preferred in the case of random type polyoxyalkylene chain, and the 70-90 weight % is particularly preferred in the case of block type polyoxyalkylene chain.

It is preferred to use the polyetherpolyol having 1000 - 10000 of the molecular weight, particularly 2000 - 10000 in the case of tri or more polyfunctional polyetherpolyols obtained by originating from tri or more polyhydric alcohols.

The preferred examples of the polyetherpolyols represented by the above general formula (I) are the difunctional polyetherpolyols represented by the following general formula,

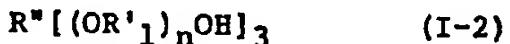


(where R' is dihydric alcohol radical;  $(OR'_1)_n$  is polyoxyalkylene chain comprising 50-90 weight % of oxyethylene unit and 50-10 weight % of oxypropylene unit; n is the number which represents the polymerization degree of said polyoxyalkylene chain, such n restricts the hydroxy group equivalent of the polyetherpolyol 500 - 4000).

The preferred examples of such difunctional polyetherpolyols are the polyethers having 500 - 4000 of hydroxy group equivalent and 50-90 weight % ethylene oxide content obtained by adducting

ethylene oxide and propylene oxide to propylene glycol in random or block.

The another preferred examples of the polyetherpolyols represented by the above general formula (I) are the trifunctional polyetherpolyols represented by the following general formula,



(where  $R''$  is trihydric alcohol radical;  $(OR'_1)_n$  is polyoxyalkylene chain comprising 50-90 weight % of oxyethylene unit and 50-10 weight % of oxypropylene unit;  $n$  is the number which represents the polymerization degree of said polyoxyalkylene chain, such  $n$  restricts the hydroxy group equivalent of the polyetherpolyol 500 - 4000).

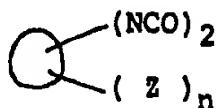
The preferred examples of such trifunctional polyetherpolyols are the polyethers having 500 - 4000 of hydroxy group equivalent and 50-90 weight % ethylene oxide content obtained by adducting ethylene oxide and propylene oxide to propylene glycol in random or block.

It is preferred to use, as the water-swellable polyurethane prepolymer (I) of the present invention, the terminal NCO group containing prepolymer obtained by reacting polyisocyanates with the mixture of difunctional polyetherpolyol (I-1) obtained by originating from dihydric alcohols such as propylene glycol and trifunctional polyetherpolyol (I-2) obtained by originating from trihydric alcohols such as glycerol.

It is specially preferred to mix difunctional polyetherpolyol (I-1) and trifunctional polyetherpolyol (I-2) on the weight ratio 9 : 1 - 7 : 3.

The examples of polyisocyanates of the present invention are

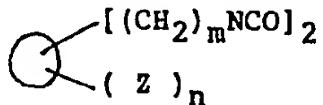
the isocyanates represented by the following general formula



(where  $\textcircled{C}$  is the benzene ring or naphthalene ring, -NCO is ring substituted isocyanate group, z is ring substituted halogen atom or alkyl or alkoxy group having 3 or less carbon atoms, n is the number 0, 1, or 2)

such as 2,4-toluenediisocyanate, 2,6-toluenediisocyanate, 1,4-naphthylene diisocyanate, 1,5-naphthylene diisocyanate, 1,3-phenylene diisocyanate, 1,4-phenylene diisocyanate, 1-isopropylbenzene-2,4-diisocyanate;

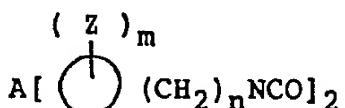
the isocyanates represented by the following general formula



(where  $\textcircled{C}$  is the benzene ring or naphthalene ring,  $(\text{CH}_2)_m\text{NCO}$  is ring substituted alkylene isocyanate group, z is ring substituted halogen atom or alkyl or alkoxy group having 3 or less carbon atoms, n is the number 0, 1, or 2)

such as  $\omega, \omega'$ -diisocyanate-1,2-dimethylbenzol,  $\omega, \omega'$ -diisocyanate-1,3-dimethylbenzol;

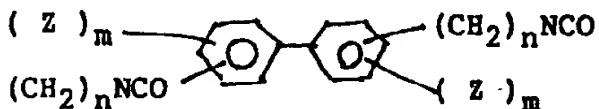
the isocyanates represented by the following general formula



(where A is  $-\text{CH}_2-$  or alkylene group having 3 or more carbon atoms such as  $\text{CH}_3-\text{C}(\text{CH}_3)-\text{CH}_3$ ,  $\textcircled{C}$  is the benzene ring or naphthalene ring, z is ring substituted halogen atom or alkyl or alkoxy group having 3 or less carbon atoms, n is the number 0, 1, or 2)

such as 4,4'-diphenylmethanediisocyanate, 2,2'-dimethyl diphenylmethanediisocyanate, 3,3'-dichroldiphenyldimethylmethane-4,4'-diisocyanate;

the isocyanates represented by the following general formula



(where Z is ring substituted halogen atom or alkyl or alkoxy group having 3 or less carbon atoms, m is the number 0, 1, or 2) such as biphenyl-2,4-diisocyanate, biphenyl-4,4'-diisocyanate, 3,3'-dimethylbiphenyl4,4'-diisocyanate, 3,3'-dimethoxybiphenyl-4,4' diisocyanate;

diphenylsulfone-4,4'-diisocyanate;

the isocyanates obtained by hydrogenating aromatic rings of the above mentioned isocyanates such as dicyclohexane-4,4'-diisocyanate,  $\omega, \omega'$ -diisocyanate-1,2-dimethylbenzene,  $\omega, \omega'$ -diisocyanate-1,3-dimethylbenzene;

the isocyanates having substituted urea group obtained by reacting 1 mol of water and 2 mols of diisocyanate (for example, ureadiisocyanate obtained by reacting 1 mol of water and 2 mols of 2,4-toluenediisocyanate);

urethodionediisocyanate obtained by dimerizing aromatic diisocyanates with conventional method;

propane-1,2-diisocyanate;

2,3-dimethylbutane-2,3-diisocyanate;

2-methylpentane-2,4-diisocyanate;

octane-3,6-diisocyanate;

3,3-dinitropentane-1,5-diisocyanate;

octane-1,6-diisocyanate;  
hexamethylenedisocyanate.

Water-swellable polyurethane prepolymer (1) of the present invention can be obtained by conventionally reacting polyetherpolyol represented the general formula (I) and polyisocyanate so as to get 1.5 - 10 % (preferably 1.5 - 5 %) of the terminal NCO group content. The reaction can be executed for example by heating reactants at the temperature 80 - 90°C for 2-3 hours.

The preferred examples of the polyhydric alcohols which corresponds  $R_2$  in the above general formula (II) are same alcohols such as di, tri, tetra, penta, or hexahydric alcohols mentioned above in the description of  $R$ .

Polyetherpolyols represented by the above general formula (II) can be obtained by adducting alkylene oxide having 3-4 carbon atoms to said polyhydric alcohols with conventional method, so as to get proper molecular weight. The examples of the alkylene oxide having 3-4 carbon atoms are propylene oxide and butylene oxide. Among of them, propylene oxide is particularly preferable.

It is preferred to use the polyetherpolyol having 1000 - 9000 of molecular weight, particularly 2000 - 9000 in the case of tri or more functional polyetherpolyol.

It is preferred to use, as the non water-swellable polyurethane prepolymer (2) of the present invention, the terminal NCO group containing prepolymer obtained by reacting polyisocyanate with the mixture of difunctional polyetherpolyol obtained by originating from dihydric alcohols such as propylene

glycol and trifunctional polyetherpolyol obtained by originating from trihydric alcohols such as glycerol. It is specially preferred to mix di and trifunctional polyetherpolyol on the weight ratio 9 : 1 - 1 : 9.

The suitable polyisocyanates used for preparing polyurethane prepolymer (2) are same isocyanates mentioned above in the description of polyurethane prepolymer (1). Particularly, 4-4'-diphenylmethanediisocyanate (MDI) is desirable for sealant's good adhesiveness.

Polyurethane prepolymer (2) of the present invention can be obtained by reacting conventionally polyethers and polyisocyanates for example at the temperature 90 °C for 3 hours.

Filler (3), another essential component of the sealant of the invention, can be selected from following materials; calcium carbonate, perlite, silicone oxide, talc, vermiculite, wollastonite, glass, carbon black and so on. Among of them, one or more than one material can be selected. Calcium carbonate, silicon oxide, titanium oxide, and carbon black are mostly desirable filler.

The sealant composition of the present invention can be included various plasticisers, thixotropic agents, or asphalt materials if necessary. Typical examples of the plasticisers are dioctylphthalate, of the thixotropic agents - bentonite, metal soap, hydrogenated castor oil, or asbeste powder, of the asphalt materials - coal tar, wood tar, oil gas tar, petroleum asphalt, or pitch.

The polyurethane sealant of the present invention can be

prepared by adding filler (3) to non water-swellable polyurethane prepolymer (2) to form one-package sealant (non water-swellable), further adding water-swellable polyurethane prepolymer (1) to the resulted one-package sealant. Plasticisers, thixotropic agents, and asphalt materials are preferably added with filler (3).

The preferred sealant composition of the present invention comprises 100 weight parts of non water-swellable prepolymer (2), 2 - 100 (more preferably 10 - 70) weight parts of filler (3), and 20 - 100 (more preferably 30 - 70) weight parts of water-swellable prepolymer (1).

The sealant of the present invention can be used, for example, for sealing, binding, or caulking materials in each joint of corrugated board, slate, plastic sheets, alminum sheets, sheet zinc, glass, concreat, tile pipes, road coating, floor coating, motor vehicles, boats, planes, or pipings in the field of building and construction.

The sealant of the present invention can be applied, for example, by pouring into the joint with caulking gun, coating on the surface of the material with brush, or setting cured sealant to the joint.

#### [Effect of the Invention]

The effect of the present invention is to provide a water-swellable moisture-curing one-package polyurethane sealant of which storage stability is improved. Another effect of the present invention is to provide a water-swellable moisture-curing one-package polyurethane sealant which has good mechanical strength and excellant water stopping effect.

#### [Brief description of the Drawings]

Fig. 1 is a graph showing the change of sealant's water swelling percent for time elasping.

Fig. 2 is a rough cross-section view of an apparatus used for water stopping test of water-swellable sealant.

1. steel vessel
2. polyurethane sealant
3. water pouring mouth
4. water pressure gauge

[Preferred Embodiment of the Invention]

Hereinafter part means weight part.

EXAMPLE 1

313 parts of 4,4'-diphenylmethanediisocyanate and 1500 parts of polyether having molecular weight 4500 obtained by adducting propylene oxide to glycerol were mixed and reacted at 90°C for 3 hours conventionally to obtain polyurethane prepolymer containing 3.5% of terminal NCO group content. (Prepolymer A)

23 parts of calcium carbonate and 10 parts of titanium oxide were added to 100 parts of Prepolymer A to obtain sealant composition.

20 parts of trifunctional polyether having 7000 of molecular weight and 80% of oxyethylene unit content obtained by adducting in random propylene oxide and ethylene oxide to glycerol and 80 parts of difunctional polyether having 5000 of molecular weight and 70% of oxyethylene unit content obtained by adducting in random ethylene oxide to propylene glycol were mixed. Toluenediisocyanate was added to the resulted polyether mixture and reacted at the temperature 90°C for about 3 hours to obtain

water-swellable polyurethane prepolymer having 1.8% of terminal NCO group content. (Prepolymer B)

30 parts of Prepolymer B was added to 100 parts of the sealant composition to obtain water-swellable moisture-curing one-package polyurethane sealant.

Resulted sealant had good stability and availability after 6 months storage in the atmosphere of the nitrogen gas. In order to estimate the sealant's properties, it was coated on the glass plate in thickness of 2 mm and cured at the room temperature. The mechanical strength of cured sealant was measured and illustrated in Table 1.

#### COMPARATIVE EXAMPLE 1

23 parts of calcium carbonate and 10 parts of titanium oxide were added to 100 parts of Prepolymer B to obtain sealant composition. The sealant composition remarkably increase its viscosity for 5 days in the atmosphere of nitrogen gas and half-cured for 10 days. It is obvious that the storage stability of the sealant composition of Comparative example 1 is extremely poorer than that of the sealant of Example 1.

#### EXAMPLE 2

313 parts of 4,4'-diphenylmethanediisocyanate and 2250 parts of polypropyleneglycol were mixed and reacted at 90 °C for 3 hours conventionally to obtain polyurethane prepolymer containing 2.5% of terminal NCO group content. (Prepolymer C)

23 parts of calcium carbonate and 10 parts of titanium oxide were added to 100 parts of Prepolymer C to obtain sealant composition.

30 parts of Prepolymer B was added to 100 parts of the

sealant composition to obtain water-swellable moisture-curing one-package polyurethane sealant.

Resulted sealant had good stability and availability after 6 months storage in the atmosphere of the nitrogen gas. The sealant's properties measured by the same method in Example 1 was shown in Table 1.

#### COMPARATIVE EXAMPLE 2

Prepolymer A and B obtained in Example 1 were mixed by the weight ratio 10 : 3. 23 parts of calcium carbonate and 10 parts of titanium oxide were added to 100 parts of resulted prepolymer mixture to obtain sealant composition. The sealant composition remarkably increased its viscosity for 5 days in the atmosphere of nitrogen gas and half-cured for 10 days. It is obvious that the storage stability of the sealant composition of Comparative example 2 is extreamly poorer than that of the sealnt of Examle 1.

TABLE 1

SEALANT COMPOSITION (PARTS)			SEALANT PREPARING
EXAMPLE 1	PREPOLYMER A (NON WATER-SWELLABLE)	100	Water-swellable sealant was obtained by adding Prepolymer B to the mixture of Prepolymer A and filler
	FILLER	33	
	PREPOLYMER B (WATER-SWELLABLE)	40	
COMPARATIVE EXAMPLE 1	PREPOLYMER B (WATER-SWELLABLE)	100	Sealant composition was obtained by mixing Prepolymer B and filler
	FILLER	33	
EXAMPLE 2	PREPOLYMER C (NON WATER-SWELLABLE)	100	Water-swellable sealant was obtained by adding Prepolymer B to the mixture of Prepolymer C and filler
	FILLER	33	
	PREPOLYMER B (WATER-SWELLABLE)	40	
COMPARATIVE EXAMPLE 2	PREPOLYMER A (NON WATER-SWELLABLE)	100	Sealant composition was obtained by adding filler to the mixture of Prepolymer A and Prepolymer B
	PREPOLYMER B (WATER-SWELLABLE)	30	
	FILLER	43	
STORAGE STABILITY			
CURING PROPERTY (2mm thickness)			
PROPERTIES 10 DAYS AFTER CURING			
EXAMPLE 1	Stable for 6 months in the nitrogen gas	Surface tack free : 1 day Complete curing : 1 and half day	Shore A hardness 30 Tensile strength 28 kgf/cm <sup>2</sup> Elongation 1750 %
COMPARATIVE EXAMPLE 1	Viscosity increasing for 5 days Half-cured and unavailable for 10 days in the nitrogen gas		
EXAMPLE 2	Stable for 6 months in the nitrogen gas	Surface tack free : 1 day Complete curing : 1 and half day	Shore A hardness 27 Tensile strength 25 kgf/cm <sup>2</sup> Elongation 1690 %
COMPARATIVE EXAMPLE 2	Viscosity increasing for 5 days Half-cured and unavailable for 10 days in the nitrogen gas		

**EXAMPLE 3**

20 parts of trifunctional polyether having 5000 of molecular weight obtained by adducting propylene oxide to glycerol and 80 parts of difunctional polyether having 5000 of molecular weight obtained by adducting propylene oxide to propylene glycol were mixed. 14 parts of 4,4'-diphenylmethanediisocyanate was added to the resulted polyether mixture and reacted to obtain polyurethane prepolymer having 2.5% of terminal NCO group content. (Prepolymer D)

23 parts of calcium carbonate and 10 parts of titanium oxide were added to 100 parts of Prepolymer D to obtain sealant composition.

20 parts of trifunctional polyether having 5000 of molecular weight and 70% of oxyethylene unit content obtained by adducting in random propylene oxide and ethylene oxide to glycerol and 80 parts of difunctional polyether having 5000 of molecular weight and 70% of oxyethylene unit content obtained by adducting in random ethylene oxide to propylene glycol were mixed. Toluenediisocyanate was added to the resulted polyether mixture and reacted at the temperature 90°C for about 3 hours to obtain water-swellable polyurethane prepolymer having 2.0% of terminal NCO group content. (Prepolymer E)

30 parts of Prepolymer E was added to 100 parts of the

sealant composition to obtain water-swellable moisture-curing one-package polyurethane sealant.

Resulted sealant had good stability and availability after 6 months storage in the atmosphere of the nitrogen gas.

#### COMPARATIVE EXAMPLE 3

23 parts of calcium carbonate and 10 parts of titanium oxide were added to 100 parts of Prepolymer E to obtain sealant composition. The sealant composition remarkably increased its viscosity for 5 days in the atmosphere of nitrogen gas and half-cured for 10 days. It is obvious that the storage stability of the sealant composition of Comparative example 3 is extreamly poorer than that of the sealant of Examle 3.

#### EXAMPLE 4

23 parts of calcium carbonate and 10 parts of titanium oxide were added to 100 parts of Prepolymer A to obtain sealant composition.

50 parts of Prepolymer B was added to 100 parts of the sealant composition to obtain water-swellable moisture-curing one-package polyurethane sealant.

Resulted sealant had good stability and availability after 6 months storage in the atmosphere of the nitrogen gas.

Table 2 shows properties of sealants obtained in Example 3, 4, and Comparative example 3.

TABLE 2

	STORAGE STABILITY	CURING PROPERTY (2mm thickness)	PROPERTIES 10 DAYS AFTER CURING
EXAMPLE 3	Stable for 6 months in the nitrogen gas	Surface tack free : 1 day Complete curing : 1 and half day	Shore A hardness 25 Tensile strength 20 kgf/cm <sup>2</sup> Elongation 1600 %
COMPARATIVE EXAMPLE 3	Half-cured and unavailable for 10 days in the nitrogen gas		
EXAMPLE 4	Stable for 6 months in the nitrogen gas	Surface tack free : 1 day Complete curing : 1 and half day	Shore A hardness 28 Tensile strength 26 kgf/cm <sup>2</sup> Elongation 1670 %

Fig. 1 shows water swelling percentage of water-swellable moisture-curing one-package polyurethane sealant obtained in Example 1 to 4. Following is the test method.

Cured sheet was obtained by coating the sealant on the glass plate in thickness 2 mm and leaving 10 days in the room temperature. Obtained sheet was cut in 2 x 5 cm sample piece. Each sample piece was immersed in the water and the weight increase was measured as time elasped.

$$\text{water swelling percentage (\%)} = (B - A) \times 100 / A$$

A : the weight of the sample piece before water immensed (g)

B : the weight of the sample piece after water immensed (g)

Fig. 1 also shows as a control water swelling percent of non water-swellable sealant obtained by mixing filler with Prepolymer C.

Fig 1 teaches that water swelling property of the sealants obtained in Example 1 to 4 are excellent.

Water stopping effect of the sealant was tested as method illustrated in Fig 2. The polyurethane sealants 2 obtained in Example 1 to 4 were coated on the joint of steel vessel 1 which comprises upper and lower parts. After 2 day's curing, water was poured into the vessel 1 through its water pouring mouth 3. There were no water leakage from joint on the water pressure 3 kg/cm<sup>2</sup>. This means that the sealant of the present invention has excellent water stopping effect.

#### EXAMPLE 5, 6, 7, 8

Fillers shown in Table 3 were added to 100 parts of Prepolymer D obtained in Example 3 to obtain sealant compositions. 30 parts of Prepolymer E obtained in Example 3 was added to 100 parts of each sealant composition to obtain water-swellable moisture-curing one-package polyurethane sealant. Resulted sealant had good stability and availability after 6 months storage in the atmosphere of the nitrogen gas. Table 3 shows their properties.

TABLE 3

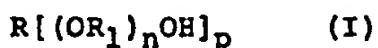
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	FILLERS	(PARTS)
EXAMPLE 5	1) calcium carbonate 2) silicone oxide 3) calcium hydroxide 4) carbon black	20 10 2 2
EXAMPLE 6	1) calcium carbonate 2) talc 3) glass powder	20 10 3
EXAMPLE 7	1) calcium carbonate 2) vermiculite 3) carbon black	20 10 2
EXAMPLE 8	1) calcium carbonate 2) wollastonite 3) titanium oxide	20 10 2
	STORAGE STABILITY	CURING PROPERTY (2mm thickness)
EXAMPLE 5	Stable for 6 months in the nitrogen gas	Surface tack free : 1 day Complete curing : 1 and half day
EXAMPLE 6	Stable for 6 months in the nitrogen gas	Surface tack free : 1 day Complete curing : 1 and half day
EXAMPLE 7	Stable for 6 months in the nitrogen gas	Surface tack free : 1 day Complete curing : 1 and half day
EXAMPLE 8	Stable for 6 months in the nitrogen gas	Surface tack free : 1 day Complete curing : 1 and half day
		PROPERTIES 10 DAYS AFTER CURING
EXAMPLE 5		Shore A hardness 26 Tensile strength 23 kgf/cm <sup>2</sup> Elongation 1610 %
EXAMPLE 6		Shore A hardness 28 Tensile strength 27 kgf/cm <sup>2</sup> Elongation 1570 %
EXAMPLE 7		Shore A hardness 26 Tensile strength 24 kgf/cm <sup>2</sup> Elongation 1600 %
EXAMPLE 8		Shore A hardness 27 Tensile strength 25 kgf/cm <sup>2</sup> Elongation 1590 %

## CLAIMS

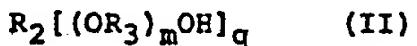
[ 1 ] The water-swellable moisture-curing one-package polyurethane sealant comprising;

(1) water-swellable polyurethane prepolymer having 1.5-10 % of terminal NCO group content obtained by reacting polyisocyanate with one or more polyetherpolyol having the following general formula,



(where R is polyhydric alcohol radical;  $(OR_1)_n$  is polyoxyalkylene chain comprising 50-90 weight % of oxyethylene unit and 50-10 weight % of oxyalkylene unit having 3-4 carbon atoms; n is the number which represents the polymerization degree of said polyoxyalkylene chain, such n restricts the hydroxy group equivalent of said polyetherpolyol (I) 500 - 4000; p is the number of 2-8)

(2) non water-swellable polyurethane prepolymer having terminal NCO groups obtained by reacting polyisocyanate with one or more polyetherpolyol having the following general formula,



(where  $R_2$  is polyhydric alcohol radical;  $(OR_3)_m$  is polyoxyalkylene chain comprising oxyalkylene unit having 3-4 carbon atoms; m is the number which represents the polymerization degree of said polyoxyalkylene chain, such m restricts the hydroxy group equivalent of said polyetherpolyol (II) 500 - 4000; q is the number of 2-8)

and (3) filler.

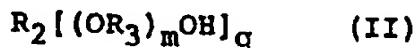
[ 2 ] The polyurethane sealant according to claim 1, comprising 20 - 100 weight parts of said water-swellable polyurethane prepolymer (1)

100 weight parts of said non water-swellable polyurethane prepolymer (2)

2 - 100 weight parts of filler (3).

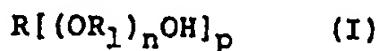
[ 3 ] A method of preparing water-swellable moisture-curing one-package polyurethane sealant comprising;

(a) mixing filler (3) and non water-swellable polyurethane prepolymer (2) having terminal NCO groups obtained by reacting polyisocyanate with one or more polyetherpolyol having the following general formula,



(where  $R_2$  is polyhydric alcohol radical;  $(OR_3)_m$  is polyoxyalkylene chain comprising oxyalkylene unit having 3-4 carbon atoms;  $m$  is the number which represents the polymerization degree of said polyoxyalkylene chain, such  $m$  restricts the hydroxy group equivalent of said polyetherpolyol (II) 500 - 4000;  $q$  is the number of 2-8) to form non water-swellable polyurethane composition,

(b) adding water swellable polyurethane prepolymer having 1.5-10 % of terminal NCO group content obtained by reacting polyisocyanate with one or more polyetherpolyol having the following general formula,



(where R is polyhydric alcohol radical;  $(OR_1)_n$  is polyoxyalkylene chain comprising 50-90 % of oxyethylene unit and 50-10 % of oxyalkylene unit having 3-4 carbon atoms; n is the number which represents the polymerization degree of said polyoxyalkylene chain, such n restricts the hydroxy group equivalent of said polyetherpolyol (I) 500 - 4000; p is the number of 2-8) to said non water-swellable polyurethane composition.

Fig. 1

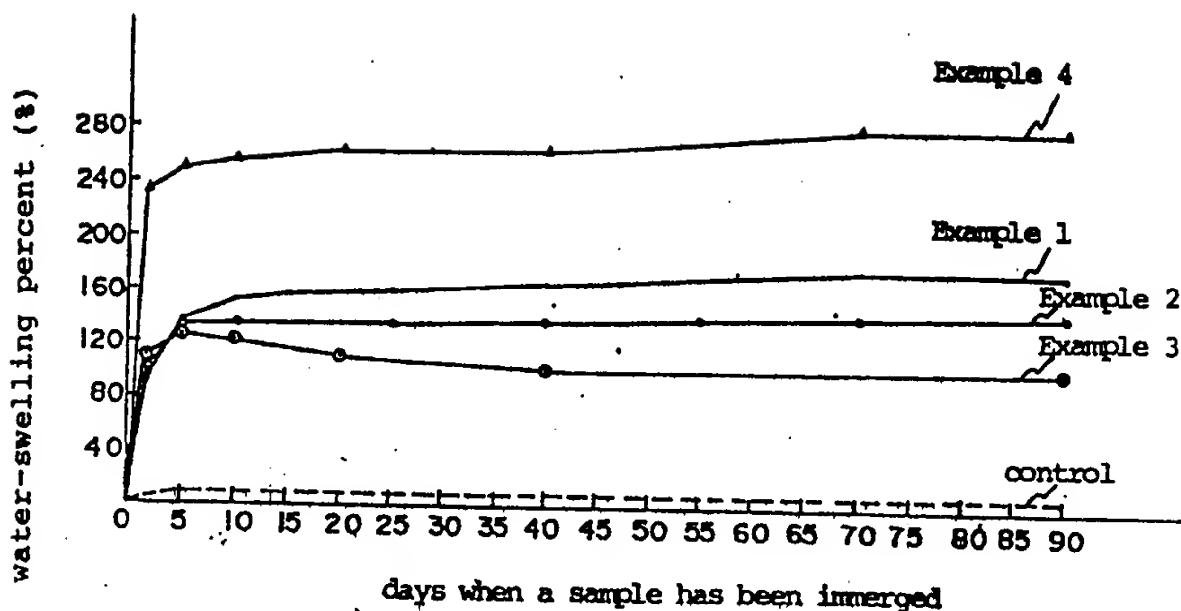
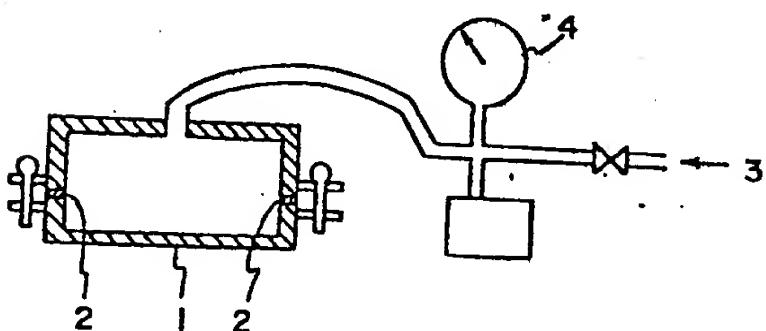


Fig. 2



# INTERNATIONAL SEARCH REPORT

International Application No.

PCT/JP85/189484

## I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) <sup>16</sup>

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl<sup>4</sup> C09K3/10

## II. FIELDS SEARCHED

Minimum Documentation Searched <sup>17</sup>	
Classification System	Classification Symbols
IPC	C09K3/10

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched<sup>18</sup>

## III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>19</sup>

Category <sup>20</sup>	Citation of Document, <sup>16</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>18</sup>
A	JP, B1, 49-30269 (Asahi Denka Kogyo Kabushiki Kaisha) 12 August 1974 (12. 08. 74) (Family : none)	1 - 3
A	JP, B2, 53-38750 (Asahi Denka Kogyo Kabushiki Kaisha) 17 October 1978 (17. 10. 78) (Family: none)	1 - 3

<sup>16</sup> Special categories of cited documents:<sup>18</sup>

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "Z" document member of the same patent family

## IV. CERTIFICATION

Date of the Actual Completion of the International Search<sup>1</sup>

September 4, 1985 (04. 09. 85)

Date of Mailing of this International Search Report<sup>1</sup>

September 17, 1985 (17. 09. 85)

International Searching Authority<sup>1</sup>

Signature of Authorized Officer<sup>22</sup>

Japanese Patent Office